

1

Energy Balance and Body Composition



In this chapter you will learn about:

- ◆ Energy balance.
- ◆ Estimating energy expenditure.
- ◆ Body composition and body fat distribution.

Maintaining a healthy body weight and body fat percentage is one of the best practices to ensure optimal health, fitness, and physical performance. The best way to maintain a healthy body weight and body fat percentage is to follow sound dietary practices and to engage in physical activity. These practices will also promote muscle endurance and strength, improve cardiorespiratory conditioning, and provide a solid foundation for optimal physical performance. In addition, people who maintain a healthy body weight have a lower risk of developing psychological problems related to low self-esteem and low self-image. All of these issues are relevant in maintaining military readiness, force health protection, and in promoting optimal health of military personnel. This chapter introduces you to the basic concepts of energy balance and body composition.

Energy Balance

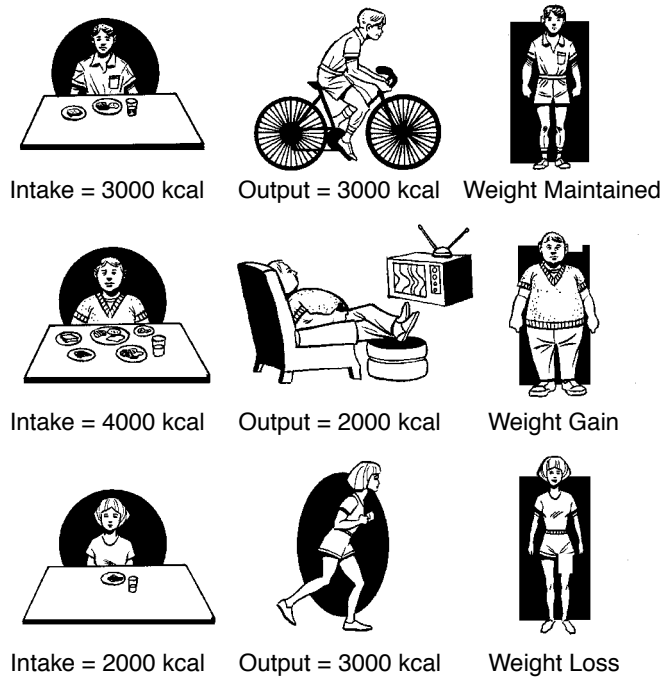
The difference between energy intake, how many kilocalories (kcal) we eat, and energy expenditure, how many kcal we burn, is termed **energy balance**. Eating the same number of kcal as you burn leads to a net energy balance of zero, and your current weight is maintained. Eating more or less kcal than you burn leads to positive (weight gain) or negative (weight loss) energy balances, respectively. See [Figure 1-1](#).



Kilocalorie
vs.
Calorie

The correct term to describe food energy is kilocalorie (kcal). However, kcals and Calories (with a capital “C”) are used interchangeably.

Figure 1-1. Energy Balance: Intake vs. Output



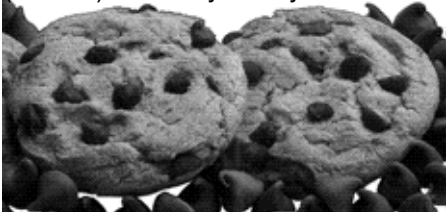
Taken from FI Katch and WD McArdle. *Nutrition, Weight Control, and Exercise*, 3rd ed. Philadelphia; Lea & Febiger, 1988.

Sensitivity of Energy Balance

This energy balance equation can be unbalanced by changing energy intake, energy expenditure, or both, as shown in the following examples. (1 pound (lbs.) of fat equals 3,500 kcal.)

Example 1:

Eating 1 extra chocolate chip cookie (65 kcal) each day for 1 year



would be: $65 \text{ kcal} \times 365 = 23,725 \text{ kcal}$.

This would add up at the end of the year to a total net weight gain of 6.8 lbs. ($23,725 \div 3,500$).

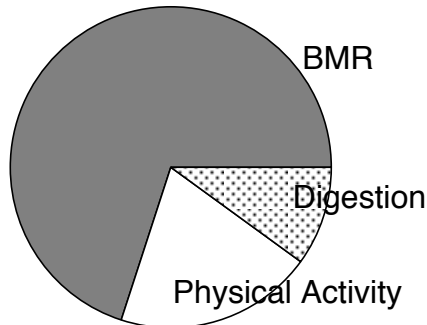
Example 2:

If you maintain your kcal intake and run an extra mile per day, 5 days per week, you would expend an extra $100 \text{ kcal/mile} \times 5 \text{ miles/week} \times 52 \text{ weeks} = 26,000 \text{ kcals}$ per year. This would result in a net weight loss of 7.4 lbs. per year ($26,000 \div 3,500$).



You see? The energy balance equation is very sensitive!

Components of Energy Expenditure



Energy requirements are based on daily energy expenditures. The three major contributors to energy expenditure are:

- ◆ Basal metabolic rate (BMR).
- ◆ Energy for digesting foods.
- ◆ Physical activity.

Basal Metabolic Rate

Basal metabolic rate (BMR) is the amount of energy required to maintain life such as breathing, beating of the heart, and maintaining body temperature. This accounts for the majority (~70%) of the total daily kcals expended. BMR can be estimated by using the equations in [Worksheet 1-1](#). Find the equation that is appropriate for you and calculate your BMR.

Worksheet 1-1. Calculate Your BMR

Equations to Calculate BMR (kcal/day)		
	Age (years):	Equation:
Men:	18-30	$6.95 \times \text{body weight (lbs.)} + 679$
	30-60	$5.27 \times \text{body weight (lbs.)} + 879$
Women:	18-30	$6.68 \times \text{body weight (lbs.)} + 496$
	30-60	$3.95 \times \text{body weight (lbs.)} + 829$
Your BMR is _____ kcal/day.		

Digestion

The body must work to digest food. However, the energy needed for digestion is only a small amount and has been accounted for in the BMR equations in [Worksheet 1-1](#).

Physical Activity

In addition to the energy used for BMR and digestion, you must account for the energy expended during your daily activities. Based on your usual daily level of activity, estimate your activity factor from the choices in [Table 1-1](#).

Table 1-1. Estimate Your Activity Factor

	Level of Activity	Activity Factor
Very Light	Seated and standing activities, driving, playing cards, computer work.	1.2
Light	Walking, sailing, bowling, light stretching, golf, woodworking, playing pool.	1.4
Moderate	Jogging, aerobic dance, light swimming, biking, calisthenics, carrying a load.	1.6
Strenuous	Stairmaster, ski machine, racquet sports, running, soccer, basketball, obstacle course, digging, carrying a load uphill, rowing.	1.9
Exceptional	Running or swimming races, cycling uphill, hard rowing, carrying heavy loads.	2.3
Your Activity Factor is _____.		

Total Daily Estimated Energy Requirement

To calculate your total daily estimated energy requirements (EER), you multiply the kcals needed for your BMR and digestion ([Worksheet 1-1](#)), by your physical activity factor ([Table 1-1](#)).

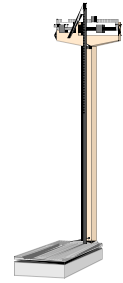
Worksheet 1-2. Calculate Your Estimated Energy Requirement (EER)

$$\text{Energy Needs} = \frac{\text{_____}}{\text{*BMR}} \times \frac{\text{_____}}{\text{*Activity Factor}}$$

$$\text{Your Estimated Energy Requirement (EER)} = \text{_____ kcal/day.}$$

*Your BMR is calculated in [Worksheet 1-1](#). The Activity Factor is from [Table 1-1](#).

This EER is the amount of kcals you need to eat daily to have an energy balance of “zero” and maintain your current body weight. If you restrict the number of kcals you eat per day, your BMR will decrease because your body will sense that it is being “starved”. If your goal is to lose weight, you should lower your caloric intake only slightly and engage in a well rounded exercise program. Your goal should be to lose 1/2 - 1 lbs. per week. If you are losing more weight than this, you are losing water and lean tissue (muscle).



If you want to gain weight, your goal should be to gain 1/2 - 1 lbs. per week. The objective is to gain **lean mass**, not fat. Exercise routinely, including strength training, and increase your caloric intake by using the Food Guide Pyramid guidelines (discussed in [Chapter 3](#)). Also, eat healthy snacks between meals.

If you have specific questions about weight management and kcal requirements, consult the **Navy Nutrition and Weight Control Self-Study Guide** (NAVPERS 15602A at <http://www-nehc.med.navy.mil> and <http://www.bupers.navy.mil/services> under “Navy Nutrition and Weight Control”), or talk to a Registered Dietitian, your Command Fitness Coordinator, or your primary health care provider.

Body Composition

The Body Mass Index (BMI) is commonly calculated for assessing body composition. It is a ratio of body weight in lbs. to body height in inches. Calculate your BMI in [Worksheet 1-3](#) and compare it to the classifications in [Table 1-2](#).



Worksheet 1-3. Calculate Your BMI

$$\text{Your BMI} = \frac{\text{Body Weight (lbs)}}{\text{Height (inches)}^2} \times 705 = \underline{\hspace{2cm}}$$

Table 1-2. Classifications for BMI Ratios

Ratio	Classification
< 20	Underweight
20-25	Normal
25-30	Overweight
> 30	Obese

Reference standards have been developed to identify individuals at risk for being either over- or underweight. However, BMI can misclassify some large frame or muscular people as overweight. It is strictly a ratio and does not necessarily reflect percent body fat accurately. If you feel your BMI incorrectly categorizes you, have your percent body fat measured by a trained professional. Body fat can be determined from a variety of techniques including hydrostatic (underwater) weighing, or from skinfolds and circumference (as done in the Navy) measures.

Fat Distribution

In addition to BMI, it is helpful to know your waist-to-hip ratio (WHR). This ratio determines your pattern of fat distribution, i.e., where you store body fat. The formula for calculating waist-to-hip ratio is:

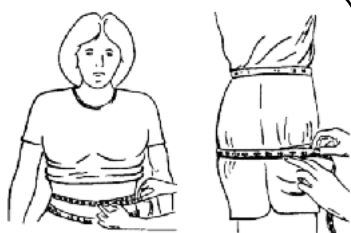
Worksheet 1-4. Calculate Your Waist-to-Hip Ratio

$$\text{Your WHR} = \frac{\text{waist circumference (inches)}}{\text{hip circumference (inches)}} = \underline{\hspace{2cm}}$$

Table 1-3. Standards for Waist-to-Hip Ratios

Men	Women
< 0.95	< 0.80

Measuring waist and hip circumferences using a tape measure.



Adapted from OPNAVINST 6110.1E, March 1998 p.7-8.

The appropriate ratios for men and women are listed in [Table 1-3](#). Ratios greater than these indicate a tendency toward central (torso) obesity. People who store excess fat centrally, as opposed to in their extremities, are at increased risk for cardiovascular (heart and blood vessel) diseases and diabetes.

This chapter serves as an anchor around which the remaining chapters have been developed. In the following chapters you will learn sound nutritional practices and ways to enhance your physical performance. Importantly, you will see how good nutrition and a balanced exercise program together influence your physical fitness, military readiness, and ultimately your overall health.